

## REPORT DOCUMENTATION PAGE

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1. REPORT DATE (DD-MM-YYYY) 10/12/2000		2. REPORT TYPE CONFERENCE PROCEEDINGS		3. DATES COVERED (From - To)	
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12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.					
13. SUPPLEMENTARY NOTES shoaling wave, surf models, space-time, wave spectrum, bathymetry and currents					
14. ABSTRACT A fundamental barrier to consequential evaluation of modem, very capable shoaling wave and surf models has been the inability to provide high-quality ocean data with which to test model results. This paper describes a development intended to satisfy this need by providing space-time visible images of the nearshore from which three parameters crucial to such evaluations are simultaneously retrieved. These fields are the wave spectrum, bathymetry and currents. A panchromatic digital framing camera has been mounted on a small aircraft and used to collect time series of images of waves as they shoal and break. The camera system is controlled by a computer-driven turret which provides accurate location and pointing angles so that the images can be mapped to the mean water level on a common geodetic reference surface. This effectively separates space and time variations associated with the waves. The resulting time series imagery can be mapped and displayed much like a movie taken from a sky hook. These data are used with algorithms to retrieve the ocean parameters of interest, specifically the wave spectrum, water depth and currents. The 3-D frequency-wavenumber spectrum is calculated in sub-regions of the nominal 2 km scene, and the theoretical dispersion relation for linear gravity waves is fit to the spectrum, with the local water depth and current as free parameters.					
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a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (Include area code) 228-688-5320

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## 4. AUTHOR

Title of Paper or Presentation  
 SPACE-TIME IMAGING OF SHOALING WAVES AND SURF

Author(s) Name(s) (First, Mi, Last), Code, Affiliation if not NRL  
 John Dugan (Arete Associates), Cindy Piotrowski (Arete Associates), Zandy Williams (Arete Associates) and K. T. Holland (NRL Code 7440.3)

It is intended to offer this paper to the 4th International Symposium on Ocean Wave Measurement and Analysis  
 (Name of Conference)  
 September 3-5, 2001, San Francisco, CA.  
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Name and Code (Principal Author)

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Branch Head acting Harris	<i>[Signature]</i>	10/16/00	
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NRL/7440/7440--00-  
1006

## Space-Time Imaging of Shoaling Waves and Surf

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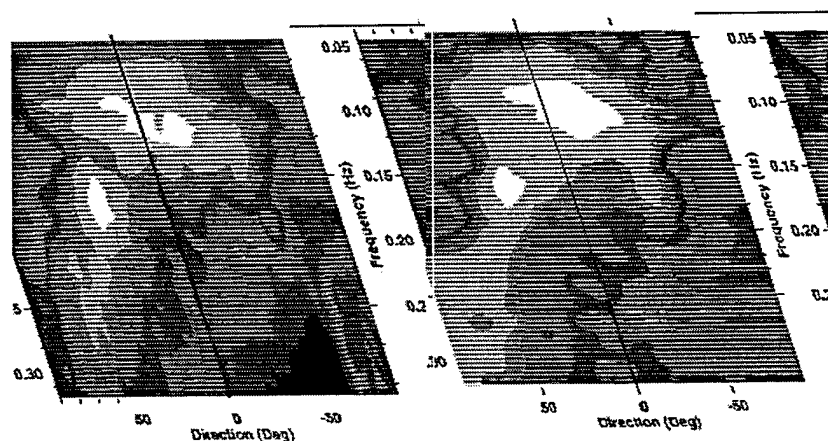
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### **Abstract**

A fundamental barrier to consequential evaluation of modern, very capable shoaling wave and surf models has been the inability to provide high-quality ocean data with which to test model results. This paper describes a development intended to satisfy this need by providing space-time visible images of the nearshore from which three parameters crucial to such evaluations are simultaneously retrieved. These fields are the wave spectrum, bathymetry and currents. A panchromatic digital framing camera has been mounted on a small aircraft and used to collect time series of images of waves as they shoal and break. The camera system is controlled by a computer-driven turret which provides accurate location and pointing angles so that the images can be mapped to the mean water level on a common geodetic reference surface. This effectively separates space and time variations associated with the waves. The resulting time series imagery can be mapped and displayed much like a *movie* taken from a sky hook (see the single frame of mapped data attached below). These data are used with algorithms to retrieve the ocean parameters of interest, specifically the wave spectrum, water depth and currents. The 3-D frequency-wavenumber spectrum is calculated in sub-regions of the nominal 2 km scene, and the theoretical dispersion relation for linear gravity waves is fit to the spectrum, with the local water depth and current as free parameters. Also, the frequency-direction (f-d) spectrum is computed by integrating the 3-D spectrum. Comparisons of these results are made with a

bathymetry survey, ADCPs, and the spectrum from the pressure array at the USACE FRF as part of the SHOaling Wave EXperiment (SHOWEX). The retrieved f-d spectrum is essentially identical to the FRF spectrum, except in instances when alongshore currents Doppler shift the higher frequency waves. Also, the retrieved water depths and currents generally are accurate to ~5% relative values. In addition, the patterns of wave breaking also are analyzed to infer the patterns of wave stress and the morphology in the surf zone, much as has been done with visible image data from the ARGUS tower-mounted video cameras in recent years.

Finally, these parameters can be retrieved across much of the 2 km imagery, so that these product fields can be compared directly with the output fields of 2-D shoaling wave and surf models. Since these are the same parameters that are essential elements of various nearshore models, we suggest that a unique use of these data sets is providing test cases for evaluating shoaling wave and surf models. Data sets were collected both at FRF and nearby Oregon Inlet during SHOWEX, so test cases could be assembled for both simple and complex morphology.



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To be presented by: Dr. John Dugan

Suggested topical sessions: **remote sensing** or **wave measurement and analysis**

Requires computer display for showing the very impressive movie loops